PATENT ABSTRACTS OF JAPAN

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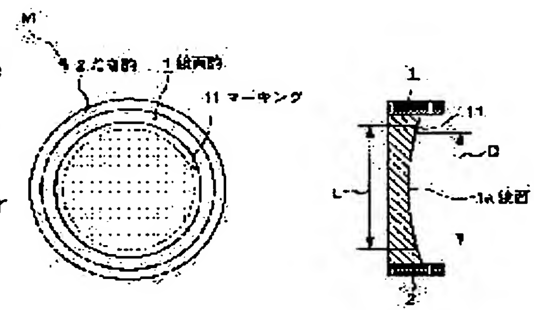
(54) STEREOSCOPIC SHAPE MEASURING METHOD AND MANUFACTURE OF PLASTIC LENS USING THE SAME

(57)Abstract:

PURPOSE: To accurately measure a plastic lens or the shape accuracy of a mold for molding the lens.

CONSTITUTION: A mold M used to mold a plastic lens has a mirror surface top 1 having a mirror surface 1a, and a wrapping top 2 for supporting the top 1. After an annular marking 11 is formed on the outer periphery of the top 1, the stereoscopic shape of the surface 1a is measured by an aspherical surface measuring unit to obtain the shape error from a designed value, the bending amount and the gradient when the mold M is set at the unit are calculated according to the data based on the marking 11, and the shape error is corrected.



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CLAIMS

[Claim(s)]
[Claim 1] The solid configuration measuring method characterized by having the process which measures the solid configuration of said device under test with a measurement means after performing marking to the predetermined part of a device under test, and obtains configuration data from the measured value, inclining with the deformation of said device under test from the data based on said marking of said configuration data, computing an amount, and amending said configuration data based on these.
[Claim 2] The manufacture approach of a plastic lens of having the process which detects the configuration precision of a die using a solid configuration measuring method according to claim 1, and corrects said die based on this, and the process which fabricates a plastic lens using the corrected die.
[Claim 3] The manufacture approach of a plastic lens of having the process which corrects the die used when detecting the configuration precision of a plastic lens using a solid configuration measuring method according to claim 1 and fabricating said plastic lens based on this, and the process which newly fabricates a plastic lens using the corrected die.
[Claim 4] The manufacture approach of the plastic lens according to claim 3 characterized by correcting the die used when detecting the amount of contraction with the configuration precision of a plastic lens and fabricating said plastic lens based on these.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the solid configuration measuring method which measures the configuration of the die used when fabricating the plastic lens of the spherical surface used for various optical system, or the aspheric surface, and this, and the manufacture approach of the plastic lens using this.
[0002]
[Description of the Prior Art] Since it is [that a plastic lens is lightweight and] moreover cheap, it is widely used for various optical system, and the case of that in which a lens configuration has an unsymmetrical thing or a very complicated lens configuration to an optical axis where a plastic lens is used is increasing in recent years.

[0003] Generally a plastic lens is manufactured by the following processes.
[0004] (1) Design a die in consideration of contraction (0.5% of abbreviation) of plastic material to the design value of a lens, and manufacture a die based on the design data.
[0005] (2) Measure the configuration precision (configuration errors, such as profile irregularity and a dimension) of the mirror plane section of the manufactured die, and this estimates a die, and check a processing mistake.
[0006] (3) Fabricate a plastic lens on the basis of various process conditions using the obtained die, evaluate the fabricated plastic lens based on configuration precision, such as a birefringence and profile irregularity, and search for the optimal process condition.
[0007] (4) If each precision of the fabricated plastic lens is insufficient, the gap with the design value of a lens will be computed, the design data of a die will be amended based on this, and a new die will be manufactured.
[0008] (5) Fabricate a plastic lens using the die manufactured by doing in this way, measure configuration precision like the above-mentioned, and check that it is in tolerance.
[0009] the difference which measurement of the configuration precision of the die in the above-mentioned process or a plastic lens measured boom hoisting on two or more straight lines using the three-dimensional measuring machine or the aspheric surface measurement machine, took the two-dimensional sequence-of-points data of a field configuration, and computed the obtained configuration data, a die and the design data of a plastic lens, and the difference with a design value, and was computed a shift and after carrying out the tilt so that this may become min -- a value makes into a configuration error.
[0010] It is for removing the component of the error which the shift and the reason for carrying out a tilt have unescapable little deflection and little inclination when setting a die and a plastic lens to the above-mentioned measurement machine, and originates configuration data in these.
[0011]
[Problem(s) to be Solved by the Invention] However, according to the above-mentioned Prior art, the unsolved technical problem that it is difficult for the configuration of a die or a plastic lens to be unable to be unsymmetrical to an optical axis, to be unable to remove correctly the component of the error by setting when setting a die and a plastic lens to a measurement machine when a lens configuration is complicated, therefore to evaluate the configuration of a die or a plastic lens correctly occurs.
[0012] Moreover, since it is what expects 0.5% of abbreviation beforehand and manufactures a die, without actually measuring contraction of plastic material, there is a possibility that the configuration precision of a lens edge may fall remarkably for the error of contraction.

[0013] complicated [solid configurations, such as a die used when this invention is made in view of the unsolved technical problem which the above-mentioned Prior art has and a plastic lens and this are fabricated,] -- it is -- even if unsymmetrical, it aims at offering the solid configuration measuring method which can measure such configuration precision correctly, and the manufacture approach of the plastic lens using this.
[0014]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the solid configuration measuring method of this invention has the process which measures the solid configuration of said device under test with a measurement means after performing marking to the predetermined part of a device under test, and obtains configuration data from the measured value, inclines with the deformation of said device under test from the data based on said marking of said configuration data, computes an amount, and is characterized by to amend said configuration data based on these.
[0015] The manufacture approach of the plastic lens of this invention detects the configuration precision of a die using a solid configuration measuring method according to claim 1, and is characterized by having the process which corrects said die based on this, and the process which fabricates a plastic lens using the corrected die.
[0016] Moreover, it is characterized by having the process which corrects the die used when detecting the configuration precision of a plastic lens using a solid configuration measuring method according to claim 1 and fabricating said plastic lens based on this, and the process which newly fabricates a plastic lens using the corrected die.
[0017] The amount of contraction may be detected with the configuration precision of a plastic lens, and the die used when fabricating said plastic lens based on these may be corrected.
[0018]
[Function] The data based on marking of a device under test are contained in the measured value measured by the measurement means. Then, if the configuration data which express the configuration precision of a device under test with comparing said measured value with a design value are computed, it inclines with deformation when a device under test is set to a measurement means, an amount is computed and configuration data are amended from the data based on said marking of the obtained configuration data based on these, the exact configuration data from which the measurement error by said deformation and amount of inclinations was removed completely can be obtained.
[0019] Thus, if it amends by evaluating the configuration of a device under test with the obtained configuration data, the product which has a very exact solid configuration can be obtained.
[0020] Moreover, in manufacture of a plastic lens, first, the configuration precision of a die is measured with the above-mentioned solid configuration measuring method, and if a die is evaluated and amended, the plastic lens which has a complicated lens configuration or an unsymmetrical lens configuration can be manufactured as a design value.
[0021] Furthermore, if the die used when measuring the configuration precision of the manufactured plastic lens with the above-mentioned solid configuration measuring method and manufacturing said plastic lens is evaluated and amended, it is much more highly precise and the plastic lens which has a complicated lens configuration or an unsymmetrical lens configuration can be manufactured as a design value.
[0022]
[Example] The example of this invention is explained based on a drawing.
[0023] Drawing 1 is what shows the die M which is a device under test in the manufacture approach of the plastic lens using the solid configuration measuring method and this by one example. This Having the mirror plane piece 1 which has mirror plane 1a which curved in the reverse configuration of the plastic lens of the shape of a convex which is not illustrated, and ****** 2 which supports the periphery edge, the mirror plane piece 1 makes the circular part which has the annular marking 11 in the periphery section of mirror plane 1a, and has the diameter D of the inside the mirror plane effective section.
[0024] Marking 11 is formed by cutting only number of width of face mum thru/or dozens of micrometers, a depth of several micrometers, or dozens of micrometers from a cutting tool along the periphery edge after mirror plane processing of the mirror plane piece 1.
[0025] Thus, graph G1 which measures the shape of surface type of the die M which performed marking (solid configuration) with the aspheric surface measurement machine which is a measurement means, computes the

gap with a design value, i.e., the configuration error which is configuration data, and is shown in drawing 2 It obtains. Let the configuration error acquired the center of marking 11, and here be a zero at this time.
[0026] the difference of the measured value obtained with the aspheric surface measurement machine when explained in detail, and a design value -- computing -- difference -- graph G1 of a value Both the troughs B1 that create and originate in marking 11, and B-2 Clearance L is measured, make that center into the zero of an axis of abscissa, and let the configuration error of this location be the zero of an axis of ordinate.
[0027] Graph G1 It sets and they are both the troughs B1 and B-2. The amount r of bending which is deformation by the following formulas using the value d of the intersection P with an epilogue and an axis of ordinate in a straight line about the both ends C1 of the inside mirror plane effective section and C2 is calculated.
[0028] r= (4xd2+D2) / the amount r of 8d bending means that the mirror plane piece 1 is deforming along with the spherical surface of a radius r, and is a graph G1 about the component of the amount r of bending. Graph G2 shown in drawing 3 when it deducts from a configuration error It is obtained.
[0029] Graph G2 of drawing 3 It sets and they are the both ends C1 of the mirror plane effective section, and C2. Graph G3 of the configuration error which deducted deformation of the mirror plane piece 1 when setting to a measurement machine, and the error by the inclination as the difference k of the configuration error which can be set was searched for, amount k/D of inclinations of the mirror plane piece 1 was computed using this and it was shown in drawing 4 in plotting the configuration error which deducted the component It can obtain.
[0030] Thus, if marking 11 is beforehand performed to the mirror plane piece 1 of Die M, even if the mirror plane piece 1 deforms by setting to a measurement machine or it leans, correctly in quest of the optical-axis location of the mirror plane piece 1, the amount of bending and the amount of inclinations can be computed, and the component of the configuration error by these can be removed completely. Therefore, the configuration of the mirror plane piece 1 can be evaluated appropriately, and required correction can be made.
[0031] Next, graph G4 of the configuration error which fabricates a plastic lens by the well-known shaping approach using the corrected die, performs marking like the above, measures the configuration, and is shown in drawing 5 It obtains. The configuration precision of a plastic lens is evaluated from this graph, and if required, a die will be corrected again.
[0032] In addition, in this example, although the aspheric surface measurement machine was used, a contact mold or a non-contact mold is sufficient as this. Moreover, ****** may be used as long as a lens configuration is the spherical surface.
[0033] Moreover, although this example performs marking so that the center of marking may serve as an optical-axis location, it may be marking in which the optical-axis location carried out eccentricity.
[0034] Furthermore, graph G4 of drawing 5 Both the troughs E1 set and according to marking, and E2 Clearance N can be found and the contraction (the amount of contraction) X by shaping of a plastic lens can be computed by the following formulas.
[0035] X=(1-N/L) x100 (%)
Thus, if a die is amended as compared with contraction which set up the computed contraction X when manufacturing a die, a highly precise plastic lens can be manufactured.
[0036] What is necessary is just to perform parallel marking 21 of the pair close to the both ends of the rectangular lens effective section, when fabricating the strip-of-paper-like plastic lens R, as the configuration of a plastic lens is not restricted circularly, for example, it is shown in drawing 6 although the plastic lens in this example is circular and marking is performed annularly.
[0037]
[Effect of the Invention] Since this invention is constituted as above-mentioned, effectiveness which is indicated below is done so.
[0038] Whether solid configurations, such as a die used when fabricating a plastic lens and this, are complicated or unsymmetrical, such configuration precision can be measured very correctly.
[0039] Moreover, the configuration precision of the die used when fabricating a plastic lens and this using such a solid configuration measuring method can be measured, and a plastic lens with a very high configuration precision can be manufactured by adding correction to this die.

[Translation done.]

* NOTICES *

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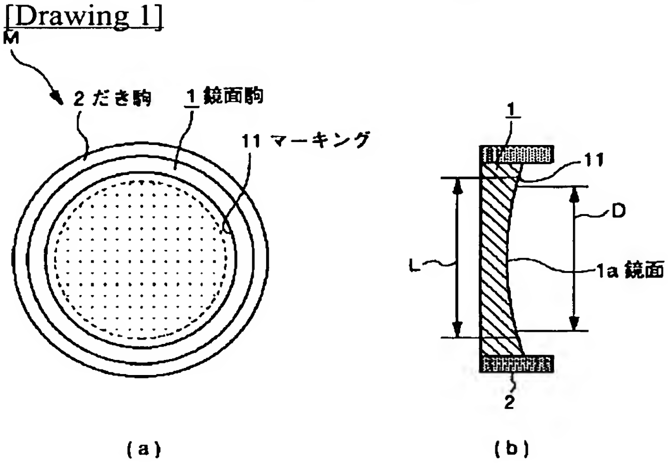
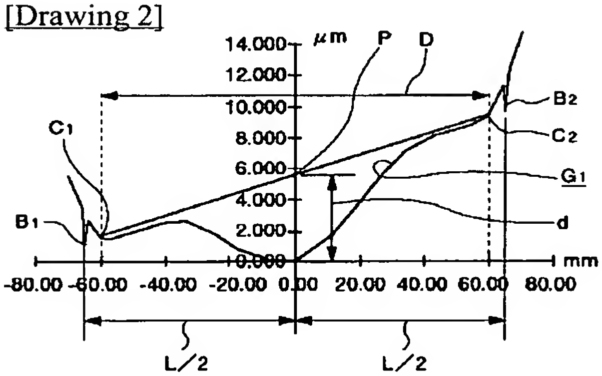
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

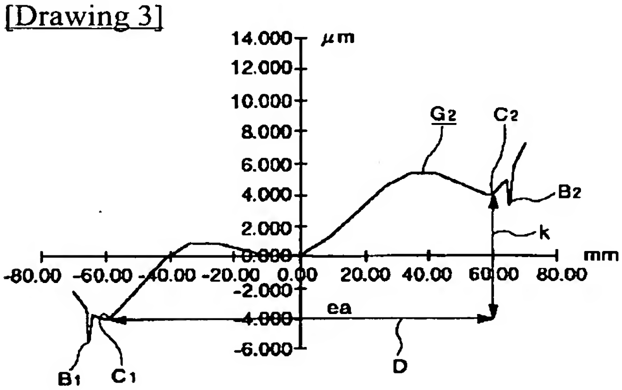
[Drawing 1]



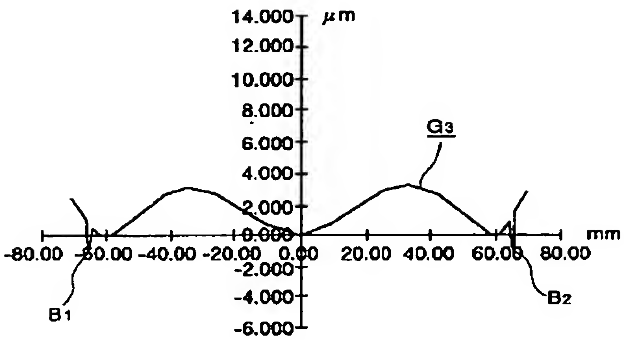
[Drawing 2]



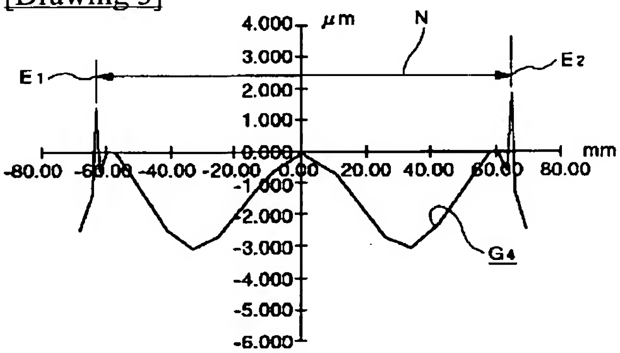
[Drawing 3]



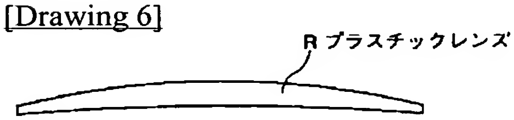
[Drawing 4]



[Drawing 5]



[Drawing 6]



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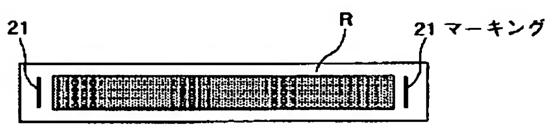

(b)

[Translation done.]

CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Section partition] The 4th partition of the 2nd section
[Publication date] January 23, Heisei 13 (2001. 1.23)

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G01B  21/20    101
G01D   3/00
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B29D  11/00
G01B  21/20    101 Z
G01D   3/00        C
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[Procedure revision]
[Filing Date] April 7, Heisei 12 (2000. 4.7)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] The name of invention
[Method of Amendment] Modification
[Proposed Amendment]
[Title of the Invention] A solid configuration measuring method and the manufacture approach of the plastic lens using this, a lens die, and a plastic lens
[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[Proposed Amendment]
[Claim(s)]
[Claim 1] The solid configuration measuring method characterized by having the process which measures the solid configuration of said device under test with a measurement means after performing marking to the predetermined part of a device under test, and obtains configuration data from the measured value, inclining with the deformation of said device under test from the data based on said marking of said configuration data, computing an amount, and amending said configuration data based on these.
[Claim 2] The manufacture approach of a plastic lens of having the process which detects the configuration precision of the die with which marking was performed using the solid configuration measuring method

according to claim 1, and corrects said die based on this, and the process which fabricates a plastic lens using the corrected die.
[Claim 3] It is the manufacture approach of the plastic lens according to claim 2 which a die has the mirror plane which has a configuration corresponding to the lens configuration to fabricate, and this mirror plane consists of the mirror plane effective section and the periphery section which encloses this mirror plane effective section, and is characterized by forming marking in said periphery section.
[Claim 4] Marking is the manufacture approach of the plastic lens according to claim 3 characterized by being formed annularly.
[Claim 5] Marking is the manufacture approach of the plastic lens according to claim 3 or 4 characterized by being formed by cutting the periphery section after processing the mirror plane of a die.
[Claim 6] The manufacture approach of a plastic lens of having the process which corrects the die used when detecting the configuration precision of the plastic lens with which marking was performed using the solid configuration measuring method according to claim 1 and fabricating said plastic lens based on this, and the process which newly fabricates a plastic lens using the corrected die.
[Claim 7] The manufacture approach of the plastic lens according to claim 6 characterized by correcting the die used when detecting the amount of contraction with the configuration precision of a plastic lens and fabricating said plastic lens based on these.
[Claim 8] It is the manufacture approach of the plastic lens according to claim 6 or 7 characterized by the plastic lens being circular and forming marking annularly.
[Claim 9] The manufacture approach of the plastic lens according to claim 8 characterized by the center of marking being in agreement with the optical-axis location of a plastic lens.
[Claim 10] It is the manufacture approach of the plastic lens according to claim 6 or 7 which a plastic lens has the lens effective section and the periphery section which encloses this lens effective section, and is characterized by approaching and preparing marking in said lens effective section.
[Claim 11] It is the lens die characterized by forming marking which it has the mirror plane which has a configuration corresponding to the lens configuration to fabricate, and this mirror plane consists of the mirror plane effective section and the periphery section which encloses this mirror plane effective section, and serves as criteria at the time of measuring the configuration of said mirror plane in this periphery section.
[Claim 12] Marking is a lens die according to claim 11 characterized by being formed annularly.
[Claim 13] The plastic lens characterized by forming marking used as the criteria at the time of having the lens effective section and the periphery section which encloses this lens effective section, and measuring a lens configuration in this periphery section.
[Claim 14] It is the plastic lens according to claim 13 characterized by the plastic lens being circular and forming marking annularly.
[Claim 15] The plastic lens according to claim 14 characterized by the center of marking being in agreement with the optical-axis location of a plastic lens.
[Claim 16] Marking is a plastic lens according to claim 13 characterized by being approached and prepared in the lens effective section.
[Procedure amendment 3]
[Document to be Amended] Specification
[Item(s) to be Amended] 0001
[Method of Amendment] Modification
[Proposed Amendment]
[0001]
[Industrial Application] This invention relates to the solid configuration measuring method which measures the configuration of the lens die for fabricating the plastic lens of the spherical surface used for various optical system, or the aspheric surface, and this etc. and the manufacture approach of the plastic lens using this, a lens die, and a plastic lens.
[Procedure amendment 4]
[Document to be Amended] Specification
[Item(s) to be Amended] 0013
[Method of Amendment] Modification
[Proposed Amendment]

[0013] complicated [solid configurations, such as a die used when this invention is made in view of the unsolved technical problem which the above-mentioned Prior art has and a plastic lens and this are fabricated,] -- it is -- even if unsymmetrical, it aims at offering the solid configuration measuring method for measuring such configuration precision correctly and obtaining a plastic lens with a high configuration precision etc. and the manufacture approach of the plastic lens using this, a lens die, and a plastic lens.
[Procedure amendment 5]
[Document to be Amended] Specification
[Item(s) to be Amended] 0015
[Method of Amendment] Modification
[Proposed Amendment]
[0015] The manufacture approach of the plastic lens of this invention detects the configuration precision of the die with which marking was performed using the solid configuration measuring method according to claim 1, and is characterized by having the process which corrects said die based on this, and the process which fabricates a plastic lens using the corrected die.
[Procedure amendment 6]
[Document to be Amended] Specification
[Item(s) to be Amended] 0016
[Method of Amendment] Modification
[Proposed Amendment]
[0016] Moreover, it is characterized by having the process which corrects the die used when detecting the configuration precision of the plastic lens with which marking was performed using the solid configuration measuring method according to claim 1 and fabricating said plastic lens based on this, and the process which newly fabricates a plastic lens using the corrected die. It is characterized by forming marking which the lens die of this invention has the mirror plane which has a configuration corresponding to the lens configuration to fabricate, and this mirror plane consists of the mirror plane effective section and the periphery section which encloses this mirror plane effective section, and serves as criteria at the time of measuring the configuration of said mirror plane in this periphery section. The plastic lens of this invention has the lens effective section and the periphery section which encloses this lens effective section, and is characterized by forming marking used as the criteria at the time of measuring a lens configuration in this periphery section.
[Procedure amendment 7]
[Document to be Amended] Specification
[Item(s) to be Amended] 0023
[Method of Amendment] Modification
[Proposed Amendment]
[0023] Drawing 1 is what shows the die (lens die) M which is a device under test in the manufacture approach of the plastic lens using the solid configuration measuring method and this by one example. This It has the mirror plane piece 1 which has mirror plane 1a which curved in the reverse configuration corresponding to the lens configuration of the plastic lens of the shape of a convex which is not illustrated, and ****** 2 which supports the periphery edge. The mirror plane piece 1 Let the circular part which has the annular marking 11 in the periphery section of mirror plane 1a, and has the diameter D of the inside be the mirror plane effective section. That is, mirror plane 1a has the mirror plane effective section and the periphery section which encloses this mirror plane effective section.

[Translation done.]

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特開平8－216272

(43)公開日　平成8年(1996)8月27日

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Ｇ０１Ｂ　21/20	１０１		Ｇ０１Ｂ　21/20	１０１Ｚ
Ｇ０１Ｄ　3/00			Ｇ０１Ｄ　3/00	Ｃ

審査請求　未請求　請求項の数４　ＦＤ　（全５頁）

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(22)出願日　平成7年(1995)2月13日

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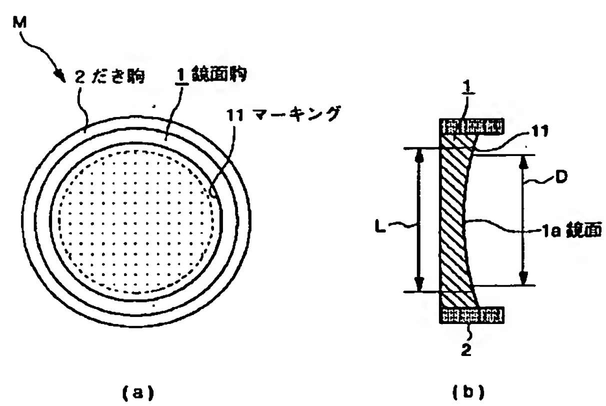
(54)【発明の名称】　立体形状測定方法およびこれを用いたプラスチックレンズの製造方法

(57)【要約】

【目的】　プラスチックレンズやこれを成形するときの成形型の形状精度を正確に測定する。

【構成】　プラスチックレンズを成形するときに用いる成形型Ｍは、鏡面１ａを有する鏡面駒１と、これを支持するだき駒２を有する。鏡面駒１の外周部に環状のマーキング１１を施したうえで鏡面１ａの立体形状を非球面測定機によって測定し、設計値との形状誤差を求め、そのうちの前記マーキング１１に基づくデータによって、成形型Ｍを非球面測定機にセットしたときのベンディング量と傾き量を算出し、前記形状誤差を補正する。



【特許請求の範囲】

【請求項１】　被測定物の所定の部位にマーキングを施したうえで前記被測定物の立体形状を測定手段によって測定しその測定値から形状データを得る工程を有し、前記形状データのうちの前記マーキングに基づくデータから前記被測定物の変形量と傾き量を算出し、これらに基づいて前記形状データを補正することを特徴とする立体形状測定方法。

【請求項２】　請求項１記載の立体形状測定方法を用いて成形型の形状精度を検出し、これに基づいて前記成形型を修正する工程と、修正された成形型を用いてプラスチックレンズを成形する工程を有するプラスチックレンズの製造方法。

【請求項３】　請求項１記載の立体形状測定方法を用いてプラスチックレンズの形状精度を検出し、これに基づいて前記プラスチックレンズを成形するときに用いた成形型を修正する工程と、修正された成形型を用いて新たにプラスチックレンズを成形する工程を有するプラスチックレンズの製造方法。

【請求項４】　プラスチックレンズの形状精度とともにその収縮量を検出し、これらに基づいて前記プラスチックレンズを成形するときに用いた成形型を修正することを特徴とする請求項３記載のプラスチックレンズの製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、各種光学系に用いられる球面あるいは非球面のプラスチックレンズやこれを成形するときに用いられる成形型等の形状を測定する立体形状測定方法およびこれを用いたプラスチックレンズの製造方法に関するものである。

【０００２】

【従来の技術】プラスチックレンズは軽量でしかも安価であるため、各種光学系に広く利用されており、近年では、レンズ形状が光軸に対して非対称のものあるいは極めて複雑なレンズ形状を有するものでもプラスチックレンズを用いる場合が増えている。

【０００３】プラスチックレンズは一般的に以下の工程によって製作される。

【０００４】（１）レンズの設計値にプラスチック材料の収縮率（略０．５％）を考慮して成形型を設計し、その設計データに基づいて成形型を製作する。

【０００５】（２）製作された成形型の鏡面部の形状精度（面精度や外形寸法等の形状誤差）を測定し、これによって成形型を評価し、加工ミスをチェックする。

【０００６】（３）得られた成形型を用いて様々な成形条件のもとにプラスチックレンズを成形し、成形されたプラスチックレンズを複屈折や面精度等の形状精度をもとに評価し、最適な成形条件を求める。

【０００７】（４）成形されたプラスチックレンズの精度がいずれも不充分であれば、レンズの設計値とのずれを算出し、これに基づいて成形型の設計データを補正し、新たな成形型を製作する。

【０００８】（５）このようにして製作された成形型を用いてプラスチックレンズを成形し、前述と同様に形状精度を測定し、公差内であることを確認する。

【０００９】上記の工程における成形型やプラスチックレンズの形状精度の測定は、３次元測定機や非球面測定機を用いて複数の直線上の起伏を測定して面形状の２次元点列データをとり、得られた形状データと、成形型やプラスチックレンズの設計データや設計値との差を算出し、これが最小になるようにシフトおよびティルトしたうえで、算出された差分値を形状誤差とする。

【００１０】形状データをシフトおよびティルトする理由は、上記の測定機に成形型やプラスチックレンズをセットするときに少量の曲がりや傾きが不可避であり、これらに起因する誤差の成分を除くためである。

【００１１】

【発明が解決しようとする課題】しかしながら上記従来の技術によれば、成形型やプラスチックレンズの形状が光軸に対して非対称であったり、レンズ形状が複雑である場合には、測定機に成形型やプラスチックレンズをセットするときのセッティングによる誤差の成分を正確に除去することができず、従って、成形型やプラスチックレンズの形状を正しく評価するのが難しいという未解決の課題がある。

【００１２】また、プラスチック材料の収縮率を実際に測定することなく、予め略０．５％と見込んで成形型を製作するものであるため、収縮率の誤差のためにレンズ端部の形状精度が著しく低下するおそれがある。

【００１３】本発明は、上記従来の技術の有する未解決の課題に鑑みてなされたものであり、プラスチックレンズやこれを成形するときに用いられる成形型等の立体形状が複雑であってもあるいは非対称であっても、これらの形状精度を正確に測定できる立体形状測定方法およびこれを用いたプラスチックレンズの製造方法を提供することを目的とするものである。

【００１４】

【課題を解決するための手段】上記目的を達成するため、本発明の立体形状測定方法は、被測定物の所定の部位にマーキングを施したうえで前記被測定物の立体形状を測定手段によって測定しその測定値から形状データを得る工程を有し、前記形状データのうちの前記マーキングに基づくデータから前記被測定物の変形量と傾き量を算出し、これらに基づいて前記形状データを補正することを特徴とする。

【００１５】本発明のプラスチックレンズの製造方法は、請求項１記載の立体形状測定方法を用いて成形型の形状精度を検出し、これに基づいて前記成形型を修正する工程と、修正された成形型を用いてプラスチックレン

ズを成形する工程を有することを特徴とする。

【００１６】また、請求項１記載の立体形状測定方法を用いてプラスチックレンズの形状精度を検出し、これに基づいて前記プラスチックレンズを成形するときに用いた成形型を修正する工程と、修正された成形型を用いて新たにプラスチックレンズを成形する工程を有することを特徴とする。

【００１７】プラスチックレンズの形状精度とともにその収縮量を検出し、これらに基づいて前記プラスチックレンズを成形するときに用いた成形型を修正してもよい。

【００１８】

【作用】測定手段によって測定された測定値には被測定物のマーキングによるデータが含まれている。そこで、前記測定値を設計値と比較することで被測定物の形状精度を表わす形状データを算出し、得られた形状データのうちの前記マーキングによるデータから、被測定物が測定手段にセットされたときの変形量と傾き量を算出し、これらに基づいて形状データを補正すれば、前記変形量や傾き量による測定誤差を完全に除去した正確な形状データを得ることができる。

【００１９】このようにして得られた形状データによって被測定物の形状を評価し、補正を行なえば、極めて正確な立体形状を有する製品を得ることができる。

【００２０】また、プラスチックレンズの製造において、まず、成形型の形状精度を上記の立体形状測定方法によって測定し、成形型を評価して補正すれば、複雑なレンズ形状あるいは非対称なレンズ形状を有するプラスチックレンズを設計値通りに製作することができる。

【００２１】さらに、製作されたプラスチックレンズの形状精度を上記の立体形状測定方法によって測定し、前記プラスチックレンズを製作するときに用いた成形型を評価して補正すれば、複雑なレンズ形状あるいは非対称なレンズ形状を有するプラスチックレンズをより一層高精度で設計値通りに製作することができる。

【００２２】

【実施例】本発明の実施例を図面に基づいて説明する。

【００２３】図１は一実施例による立体形状測定方法およびこれを用いたプラスチックレンズの製造方法における被測定物である成形型Ｍを示すもので、これは、図示しない凸面状のプラスチックレンズの逆形状に湾曲した鏡面１ａを有する鏡面駒１と、その外周縁を支持するだき駒２を有し、鏡面駒１は、鏡面１ａの外周部に環状のマーキング１１を有し、その内側の直径Ｄを有する円形部分を鏡面有効部とする。

【００２４】マーキング１１は、鏡面駒１の鏡面加工後に、その外周縁に沿って幅数μｍないし数十μｍ、深さ数μｍないし数十μｍだけバイトで切削することによって形成されたものである。

【００２５】このようにマーキングを施した成形型Ｍの表面形状（立体形状）を測定手段である非球面測定機によって測定し、設計値とのずれ、すなわち、形状データである形状誤差を算出して、図２に示すグラフG_1を得る。このとき、マーキング１１の中央とここで得られた形状誤差を原点とする。

【００２６】詳しく説明すると、非球面測定機で得られた測定値と設計値の差を算出して差分値のグラフG_1を作成し、マーキング１１に起因する両谷部B_1，B_2の離間距離Ｌを測定してその中央を横軸の原点とし、この位置の形状誤差を縦軸の原点とする。

【００２７】グラフG_1において、両谷部B_1，B_2の内側の鏡面有効部の両端C_1，C_2を直線で結び、縦軸との交点Ｐの値ｄを用いて以下の式によって変形量であるベンディング量ｒを求める。

【００２８】$r=(4\times d^2+D^2)/8d$

ベンディング量ｒは、半径ｒの球面に沿って鏡面駒１が変形していることを表わすもので、ベンディング量ｒの成分をグラフG_1の形状誤差から差し引くと図３に示すグラフG_2が得られる。

【００２９】図３のグラフG_2において、鏡面有効部の両端C_1，C_2における形状誤差の差ｋを求め、これを用いて鏡面駒１の傾き量ｋ／Ｄを算出し、その成分を差し引いた形状誤差をプロットすることで、図４に示すように、測定機にセットしたときの鏡面駒１の変形と傾きによる誤差を差し引いた形状誤差のグラフG_3を得ることができる。

【００３０】このように、成形型Ｍの鏡面駒１に予めマーキング１１を施しておけば、測定機に対するセッティングによって鏡面駒１が変形したり傾いていても、鏡面駒１の光軸位置を正確に求めてベンディング量や傾き量を算出し、これらによる形状誤差の成分を完全に除去することができる。従って、鏡面駒１の形状を適切に評価して必要な修正を行なうことができる。

【００３１】次に、修正した成形型を用いて公知の成形方法によってプラスチックレンズを成形し、上記と同様にマーキングを行ないその形状を測定し、図５に示す形状誤差のグラフG_4を得る。このグラフからプラスチックレンズの形状精度を評価して必要であれば再度成形型を修正する。

【００３２】なお、本実施例においては、非球面測定機を用いたが、これは接触型でも非接触型でもよい。また、レンズ形状が球面であれば干歩計を用いてもよい。

【００３３】また、本実施例は、マーキングの中央が光軸位置となるようにマーキングを施したものであるが、光軸位置が偏心したマーキングであってもよい。

【００３４】さらに、図５のグラフG_4において、マーキングによる両谷部E_1，E_2の離間距離Ｎを求め、以下の式によってプラスチックレンズの成形による収縮率（収縮量）Ｘを算出することができる。

【００３５】$X=(1-N/L)\times 100$（％）

このようにして算出された収縮率Ｘを成形型を製作するときに設定した収縮率と比較して成形型の補正を行なえば、より高精度のプラスチックレンズを製造することができる。

【００３６】本実施例におけるプラスチックレンズは円形であり、マーキングは環状に施されるが、プラスチックレンズの形状は円形に限らず、例えば、図６に示すように短冊状のプラスチックレンズＲを成形するときは、長方形のレンズ有効部の両端に近接した一対の平行なマーキング２１を施せばよい。

【００３７】

【発明の効果】本発明は上述のとおり構成されているので、次に記載するような効果を奏する。

【００３８】プラスチックレンズやこれを成形するときに用いる成形型等の立体形状が複雑であってもあるいは非対称であっても、これらの形状精度を極めて正確に測定できる。

【００３９】また、このような立体形状測定方法を用いてプラスチックレンズやこれを成形するときに用いた成形型の形状精度を測定し、該成形型に修正を加えることで、極めて形状精度の高いプラスチックレンズを製造することができる。

【図面の簡単な説明】

【図１】一実施例によるプラスチックレンズの製造方法に用いる成形型を示すもので、（ａ）はその立面図、（ｂ）は断面図である。

【図２】測定機に対するセッティングによる誤差を除く前の成形型の形状誤差を示すグラフである。

【図３】ベンディング量による誤差の成分を除いた後の形状誤差を示すグラフである。

【図４】傾き量による誤差の成分を除いた後の形状誤差を示すグラフである。

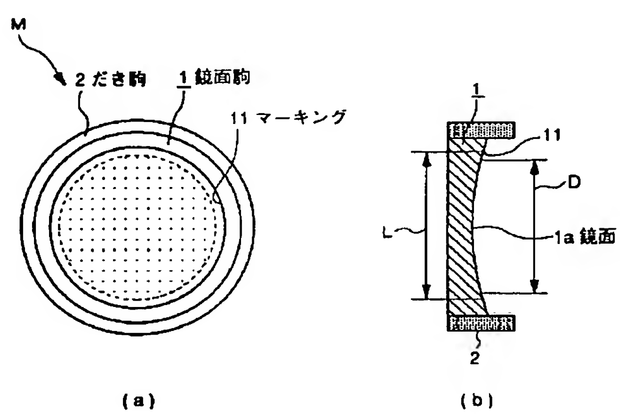
【図５】測定機に対するセッティングによる誤差を除いたプラスチックレンズの形状誤差を示すグラフである。

【図６】プラスチックレンズが短冊状である場合を示すもので、（ａ）は立面図、（ｂ）は平面図である。

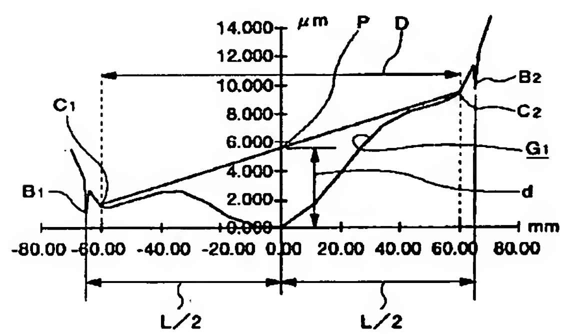
【符号の説明】

１　　鏡面駒
１ａ　　鏡面
２　　だき駒
１１，２１　　マーキング

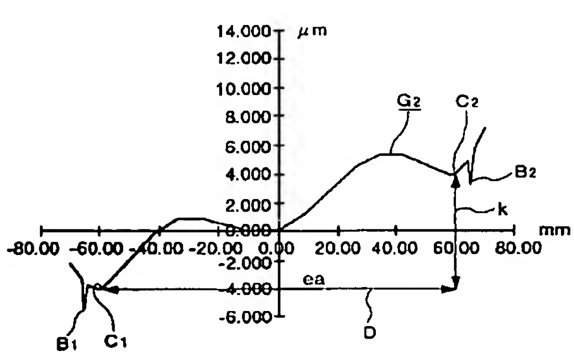
【図１】



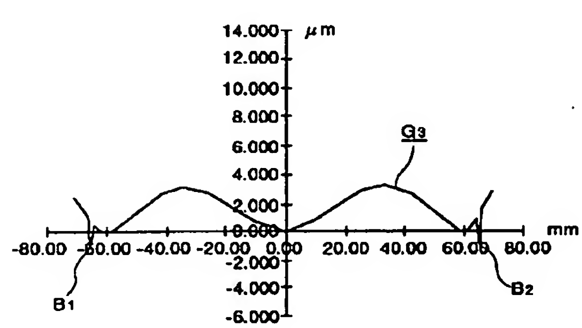
【図２】



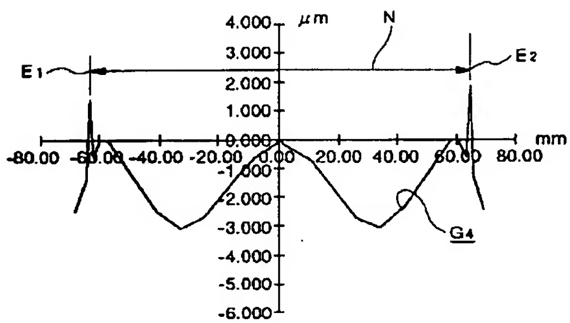
【図３】



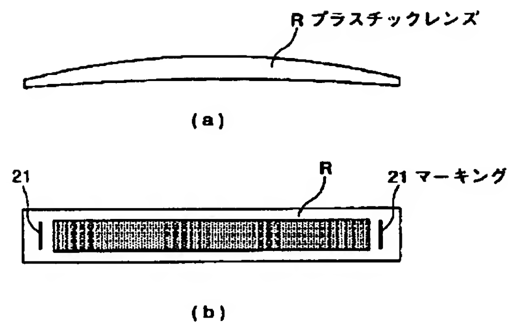
【図４】



【図５】


4.000
3.000
2.000
1.000
0.000
-1.000
-2.000
-3.000
-4.000
-5.000
-6.000
μm
N
E1
E2
-80.00
-60.00
-40.00
-20.00
0.00
20.00
40.00
60.00
80.00
mm
G4

【図６】


R プラスチックレンズ
(a)
21
R
21 マーキング
(b)